

## DEMOGRAPHY OF WINTERING ROUGH-LEGGED HAWKS IN NEW JERSEY

THOMAS BOSAKOWSKI<sup>1</sup>

*Department of Biological Sciences, Rutgers University, Newark, NJ 07102*

DWIGHT G. SMITH

*Department of Biology, Southern Connecticut State University, New Haven, CT 06515*

**ABSTRACT.**—We compiled Christmas Bird Count data on Rough-legged Hawk (*Buteo lagopus*) numbers from New Jersey for 1954 to 1989. Analysis state-wide revealed patterns not formerly observed on the continental or local scales. Major concentrations of wintering Rough-legged Hawks were along coastal areas in southern New Jersey. This abundance pattern was positively correlated with county wetland percentage and number of frost-free days. Considering previous studies which have found this species to avoid snow cover, it appears that these coastal marshes provide the proper habitat-climate gradient most favored by Rough-legged Hawks wintering in New Jersey. Throughout the period examined, no overall change in population size was observed.

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Demografía de la aguililla de la especie *Buteo lagopus* en el invierno, en Nueva Jersey

**EXTRACTO.**—Del conteo de aves que se realiza en navidad, hemos analizado datos referentes a la aguililla de la especie *Buteo lagopus*, en Nueva Jersey, desde 1954 hasta 1989. Estos análisis, que incluyen data de todo el estado, revelaron tendencias demográficas que no han sido observadas anteriormente a escala continental o local.

Las mayores concentraciones del *B. lagopus*, en invierno, estuvieron a lo largo de las áreas costeras del sur de Nueva Jersey. Esta norma de abundancia ha sido positivamente correlacionada con el porcentaje de tierras húmedas en el estado, y con el número de días sin heladas. Considerando estudios previos, que han encontrado esta especie evadiendo zonas cubiertas de nieve, parece ser que estos esteros costeros proveen la gradiente de hábitat-clima apropiado que es mayormente preferido por el *B. lagopus* en invierno, en Nueva Jersey. A través del período examinado no se observaron cambios mayores en el tamaño poblacional.

[Traducción de Eudoxio Paredes-Ruiz]

In North America, the Rough-legged Hawk (*Buteo lagopus*) is a tundra-nesting raptor in the high arctic of Canada and Alaska (Cade 1955, Poole and Bromley 1988) but it winters throughout much of the United States (Root 1988). Thus, conservation and management of this large *Buteo* depend upon factors affecting its habitats in both Canada and the United States.

Previous investigations on the winter ecology of the Rough-legged Hawk have focused primarily on obtaining local and regional abundance estimates. Graber and Golden (1960) analyzed Christmas Bird Count data in Illinois from 1905 to 1955 to examine trends in raptor populations. Density estimates based

on road transect surveys have been reported by Schnell (1967), Call (1975), Phelan and Robertson (1978), Baker and Brooks (1981) and Andersen et al. (1985). Some studies correlated abundance with habitat preference (St. John 1980, Fischer et al. 1984, Bildstein 1978).

Continent-wide winter distributions of Rough-legged Hawks based on Christmas Bird Count data were described by Bock and Lepthien (1976) and Root (1988). Wintering concentrations of Rough-legged Hawks in the Great Plains and intermountain area were correlated primarily with climatic conditions and presence of protected habitats such as wildlife refuge areas (Root 1988). However, while continent-wide studies are useful in documenting broad distribution patterns, such studies do not address the relationships between Rough-legged Hawk abundance and macrohabitat, a fundamental component of population management.

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<sup>1</sup> Present address: Utah Division of Wildlife Resources, 1465 W 950 N, Fisheries Experiment Station, Logan, UT 84321.

In this investigation, we used a state-wide analysis to explore relationships between wintering Rough-legged Hawks and macrohabitat preferences based on numbers recorded on Christmas Bird Counts in New Jersey. We describe the results of this analysis and evaluate their potential use for conservation.

#### METHODS

New Jersey was selected for this analysis because 1) it has one of the densest concentrations of Christmas Bird Count (CBC) stations of any state, 2) the distribution of stations is fairly uniform throughout the state producing a representative geographic sampling, 3) the state contains a large diversity of macrohabitats (Fig. 1A) including: coastal marshes, coastal plain (including the pinelands), piedmont, highlands, and ridge and valley, 4) the authors have spent over a decade observing Rough-legged Hawks in various New Jersey habitats.

Data were tabulated from annual CBC counts published in *American Birds* and *Audubon Field Notes* from 1954 to 1989. To compare trends in distribution, count data for each CBC station were standardized as numbers per party-hours to account for different measures of field effort between years (Raynor 1975). A map of New Jersey was used to plot the approximate center of CBC location (by coordinates) and symbols of different sizes were used to illustrate size classes of population density of Rough-legged Hawks (mean number per 1000 party-hours from 1965–84). The distribution map was then overlaid with maps of county wetland percentages (from Tiner 1985), physiographic provinces, frost-free days, and human population density per county (Robichaud and Buell 1973) to evaluate demographic patterns in hawk abundance. Linear regression analysis (Zar 1974) was used to determine the strength of correlations between demographic variables and the mean winter abundance of Rough-legged Hawks at 25 CBC stations. The significance of slopes was determined by ANOVA (Zar 1974).

We also totaled counts for all stations each year to illustrate the magnitude of yearly fluctuations in Rough-legged Hawk populations within the state. To do this, we calculated 1) the log of the total number of hawks per total number of party-hours per year and 2) the yearly proportion of CBCs in which this species was recorded. If a Rough-legged Hawk was reported as present in the count area during the count week, but not seen on the count, we recorded one individual unless a larger number was given.

#### RESULTS AND DISCUSSION

**Distribution.** The CBC data suggest that wintering Rough-legged Hawks are widely distributed throughout New Jersey (Fig. 1A). The distribution map suggests a marked preference of these wintering hawks for the southern New Jersey coastal areas. Conversely, the overall distribution pattern shows a general avoidance of highland and inland areas. Although Rough-legged Hawks were recorded at almost all New Jersey CBC stations that were active

for 10 or more years, they were rarely observed at several inland count stations (including Trenton, Northwest Gloucester County, Northwest Hunterdon County and Walnut Valley). Such an obvious pattern of distribution is not apparent using CBC data presented on a continental scale (Bock and Lepthien 1976, Root 1988).

**Habitat Relationships.** The abundance of wetlands correlated significantly ( $r = 0.61$ ,  $N = 25$ ,  $P < 0.002$ ) with the abundance of Rough-legged Hawks along the outer coastal plain (Fig. 1B), except for Monmouth county which is the most heavily populated county in this physiographic region (Robichaud and Buell 1973). However, the abundance of wetlands seems to be of less importance on the inner coastal plain and pinelands area (Gloucester and Burlington counties). This discrepancy is partially explainable based on the type of wetlands predominating in each region (Tiner 1985). The wetland percentages for outer coastal counties represent mostly broad expanses of open marsh environments (salt and freshwater) which are dominated locally by emergent vegetation such as cattail (*Typha* sp.), common reed (*Phragmites communis*), and several *Spartina* species. The physiognomy of these palustrine wetland habitats resembles the sedge, heath, and willow vegetational communities of the tundra that Rough-legged Hawks use for foraging during the nesting season (Smith et al. in press). A preference for open habitats by wintering Rough-legged Hawks has also been noted by others (Weller 1964, Schnell 1968, St. John 1980, Fischer et al. 1984) and is consistent with a species which spends each breeding season exclusively on the open tundra.

The abundance of Rough-legged Hawks in New Jersey decreased within the inner coastal plain and pinelands area (Gloucester and Burlington counties) despite the presence of wetlands. The predominant wetlands in these counties include wooded swamps and bogs (Tiner 1985), which may limit foraging opportunities for this open country raptor. Other inland and highland areas in northern New Jersey also yielded low counts of Rough-legged Hawks, most likely because these areas are extensively wooded and provide little open habitat.

Root (1988) found an association of Rough-legged Hawks with National Wildlife Refuges and attributed this to the availability of protected and managed environments within the refuge boundaries. Most wildlife areas that Root (1988) specifically noted center on or include important wetland components.

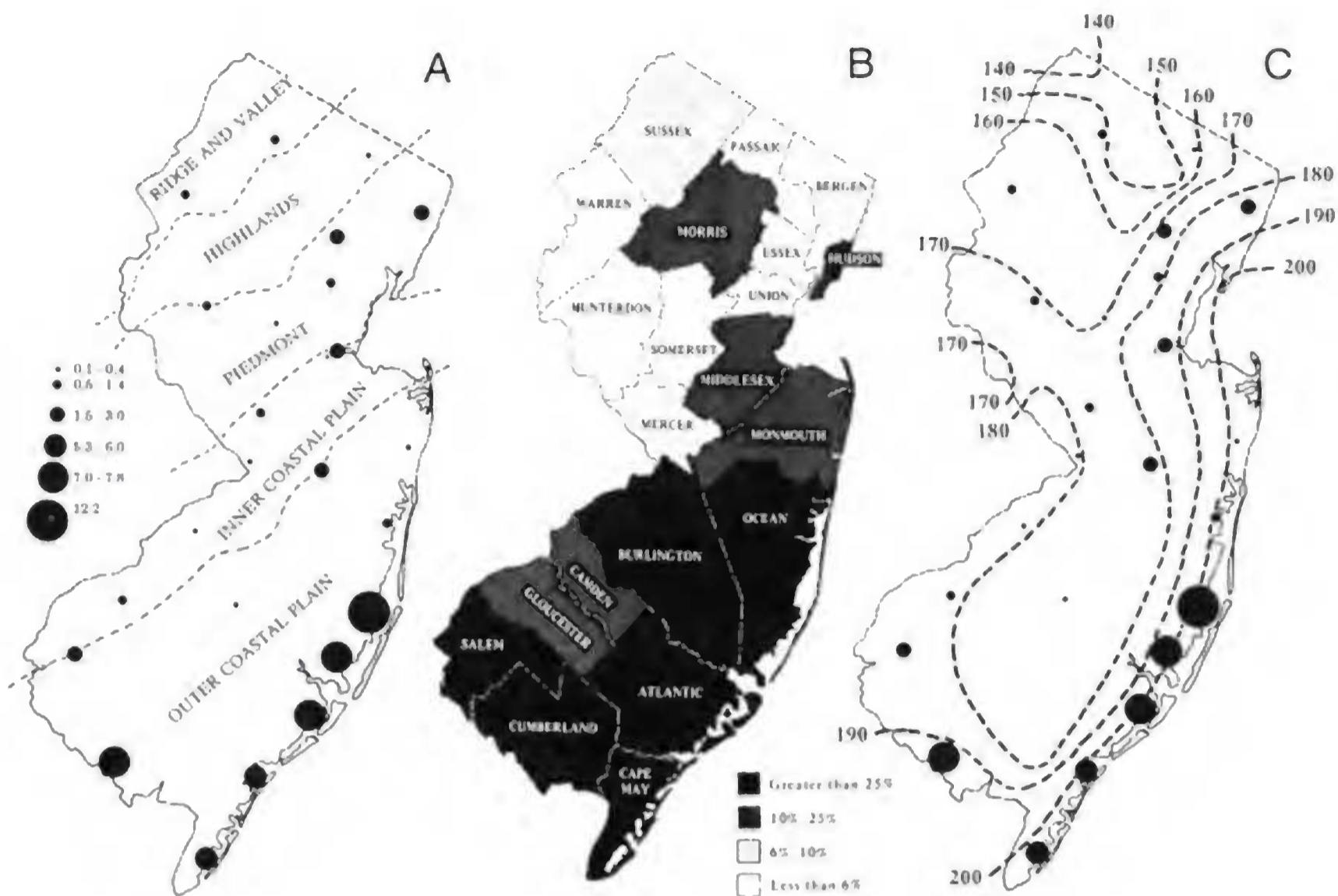


Figure 1. Winter Rough-legged Hawk abundance (birds per 1000 party-hours) from New Jersey Christmas Bird Counts in relation to A) physiographic regions, B) county wetland percentages (from Tiner 1985), and C) number of frost-free day isolines (Robichaud and Buell 1973).

Hence, Rough-legged Hawks may be responding to the structurally similar features of wetlands and tundra habitats rather than a protected and managed environment, especially since most New Jersey wetlands which are used by Rough-legged Hawks are heavily disturbed and modified. Our observations of Rough-legged Hawks wintering each year in the Hackensack Meadowlands, an inland tidal area characterized by large scale habitat alteration, industrialization, and high levels of human activity, suggest that this *Buteo* can tolerate a wide range of human disturbance and habitat alteration.

**Climatic relationships.** Despite its panboreal distribution, several researchers have noted that Rough-legged Hawks avoid snow cover on their wintering grounds (Schnell 1968, Watson 1986, Sone-nerud 1986). To examine the effect of winter climate, we compared the New Jersey Rough-legged Hawk distribution to the number of frost-free days (Fig.

1C). In this case, a positive correlation ( $r = 0.55$ ,  $N = 25$ ,  $P < 0.005$ ) between hawk abundance and warmer climate was apparent. Root (1988) noted that this raptor is absent from regions where average minimum mid-January temperatures are below  $-6^{\circ}\text{C}$ , or areas that receive less than 102 cm of precipitation per year. Frequent snow cover was also noted as a negative factor in Rough-legged Hawk distribution by Schnell (1968), Watson (1986) and Sone-nerud (1986). Most of these investigators have speculated that Rough-legged Hawks may have greater difficulties in prey detection and capture with significant snow cover.

**Winter Population Trends.** The winter abundance of Rough-legged Hawks in New Jersey often showed wide variations between years (Fig. 2A). Lowest numbers were recorded in 1956 and 1967 (1.5 and 1.6 hawks per 100 party-hours, respectively) and highest numbers in 1963 and 1964 (7.8 and 7.3,

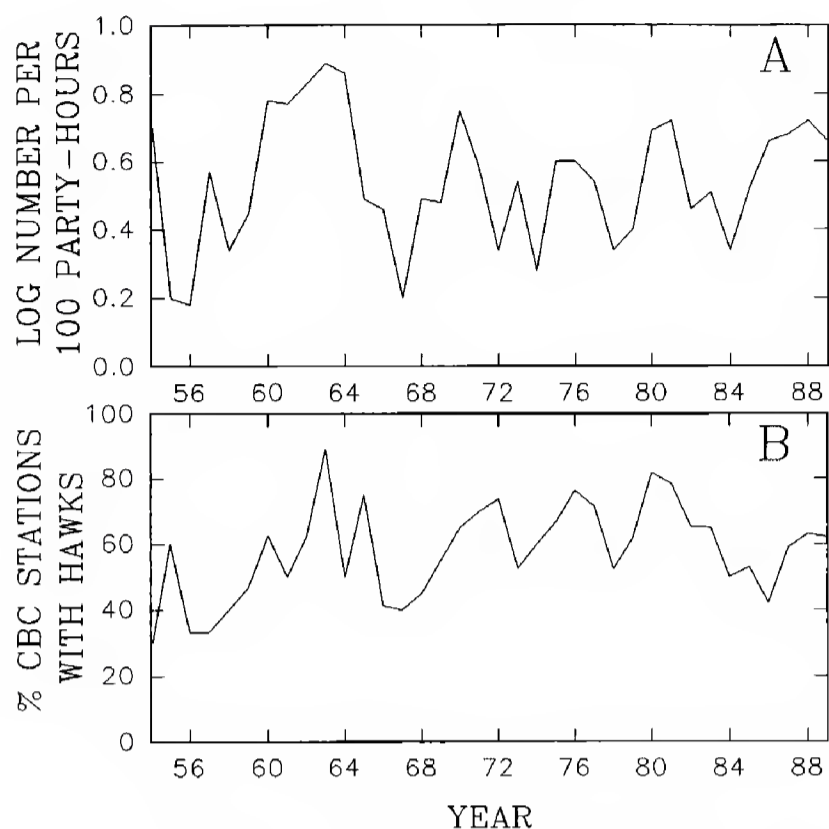


Figure 2. Winter population trends of Rough-legged Hawks from Christmas Bird Counts (1954–89) in New Jersey represented by A) the log number of birds per 100 party-hours and B) percent of CBC stations reporting Rough-legged Hawks.

respectively). No significant changes in population size were detected with linear regression analysis ( $P > 0.4$ ), and the abundance of this *Buteo* during the 1980s did not differ appreciably from previous decades.

The percentage of CBC stations at which Rough-legged Hawks were recorded also showed wide variations (Fig. 2B), ranging from 27% in 1954 to 89% in 1963. The highest percentage of stations recording Rough-legged Hawks occurred during the winter of the hawk's greatest abundance, suggesting that Rough-legged Hawks were both abundant and widespread in that year. In other years, however, increases in Rough-legged Hawk abundance was a function of greater numbers of individuals at only a few stations and, overall, numbers of individuals recorded did not always track with the percentage of stations recording this *Buteo*.

Despite the sometimes dramatic changes in Rough-legged Hawk numbers between years, the overall wintering abundance of this species appears to remain steady in New Jersey. Titus et al. (1989) also noted an among-year variability and lack of pronounced changes in numbers of Rough-legged Hawks in the northeastern United States.

In conclusion, the southern New Jersey coastal areas provide open marsh habitats, warmer climate, and less persistent snow cover than highland areas. These factors may operate simultaneously in creating the proper habitat-climate gradient favored by wintering Rough-legged Hawks. Thus, the preservation of Atlantic coastal marshes is of critical importance in the conservation of the Rough-legged Hawk. Although populations of this wintering raptor do not appear to be in decline, the results of this paper suggest that continued destruction of U.S. coastal wetlands could be responsible for future declines in Canadian Rough-legged Hawk breeding populations.

#### LITERATURE CITED

- ANDERSEN, D.E., O.J. RONGSTAD AND W.R. MYTTON. 1985. Line transect analysis of raptor abundance along roads. *Wildl. Soc. Bull.* 13:533–539.
- BAKER, J.A. AND R.J. BROOKS. 1981. Distribution patterns of raptors in relation to density of meadow voles. *Condor* 83:42–47.
- BILDSTEIN, K.L. 1978. Behavioral ecology of Red-tailed Hawks (*Buteo jamaicensis*), Rough-legged Hawks (*B. lagopus*), Northern Harriers (*Circus cyaneus*), American Kestrels (*Falco sparverius*) and other raptorial birds wintering in south-central Ohio. Ph.D. thesis, Ohio State University, Columbus, OH.
- BOCK, C.E. AND L.W. LEPHIEN. 1976. Geographical ecology of the common species of *Buteo* and *Parabuteo* wintering in North America. *Condor* 78:554–557.
- CADE, T.J. 1955. Variation of the Common Rough-legged Hawk in North America. *Condor* 57:313–346.
- CALL, D.J. 1975. Seasonal hawk population densities in southeastern South Dakota. *Proc. South Dakota Acad. Sci.* 54:172–177.
- FISCHER, D.L., K.L. ELLIS AND R.J. MEESE. 1984. Winter habitat selection of diurnal raptors in central Utah. *Raptor Res.* 18:98–102.
- GRABER, R.R. AND J.S. GOLDEN. 1960. Hawks and owls: population trends from Illinois Christmas Counts. *Biol. Notes Ill. Nat. Hist. Surv.* 41:2–24.
- PHELAN, F.J.S. AND R.J. ROBERTSON. 1978. Predatory response of a raptor guild to changes in prey density. *Can. J. Zool.* 56:2565–2572.
- POOLE, K.G. AND R.G. BROMLEY. 1988. Interrelationships within a raptor guild in the central Canadian Arctic. *Can. J. Zool.* 66:2275–2282.
- RAYNOR, G.S. 1975. Techniques for evaluating and analyzing Christmas Bird Count data. *Amer. Birds* 29: 626–633.
- ROBICHAUD, B. AND M.F. BUELL. 1973. Vegetation of New Jersey: a study of landscape diversity. Rutgers University Press, New Brunswick, NJ.

- ROOT, T. 1988. Atlas of wintering North American birds. University of Chicago Press, Chicago, IL.
- SCHNELL, G.D. 1967. Population fluctuations, spatial distribution, and food habits of Rough-legged Hawks in Illinois. *Kansas Ornithol. Soc. Bull.* 18:21-28.
- . 1968. Differential habitat utilization by wintering Rough-legged and Red-tailed Hawks. *Condor* 70:373-377.
- SMITH, D.G., J.A. BALL AND D. ELLIS. Management of people and raptors on the Noatak River, Alaska. The Wilderness. Peregrine Press, Las Vegas, NV. In press.
- SONERUD, G.A. 1986. Effect of snow cover on seasonal changes in diet, habitat, and regional distribution of raptors that prey on small mammals in boreal zones of Fennoscandia. *Holarctic Ecol.* 9:33-47.
- ST. JOHN, T. 1980. Species, abundances, and habitat preferences of diurnal raptors wintering on Crab Orchard National Wildlife Refuge. *Trans. Ill. State Acad. Sci.* 73:21-28.
- TINER, R.W. 1985. Wetlands of New Jersey. USFWS Natl. Wetlands Inventory, Newton Corner, MA.
- TITUS, K., M.R. FULLER, D.F. STAUFFER AND J.R. SAUER. 1989. Buteos. Pages 53-64 in Northeast Raptor Management Symposium and Workshop. National Wildlife Federation Sci. Tech. Series No. 13, Washington, DC.
- WATSON, J.W. 1986. Temporal fluctuations of Rough-legged Hawks during carrion abundance. *Raptor Res* 20:42-43.
- WELLER, M.W. 1964. Habitat utilization of two species of Buteos wintering in central Iowa. *Iowa Bird Life* 34. 58-62.
- ZAR, J.H. 1974. Biostatistical analysis. Prentice-Hall, Englewood Cliffs, NJ.

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